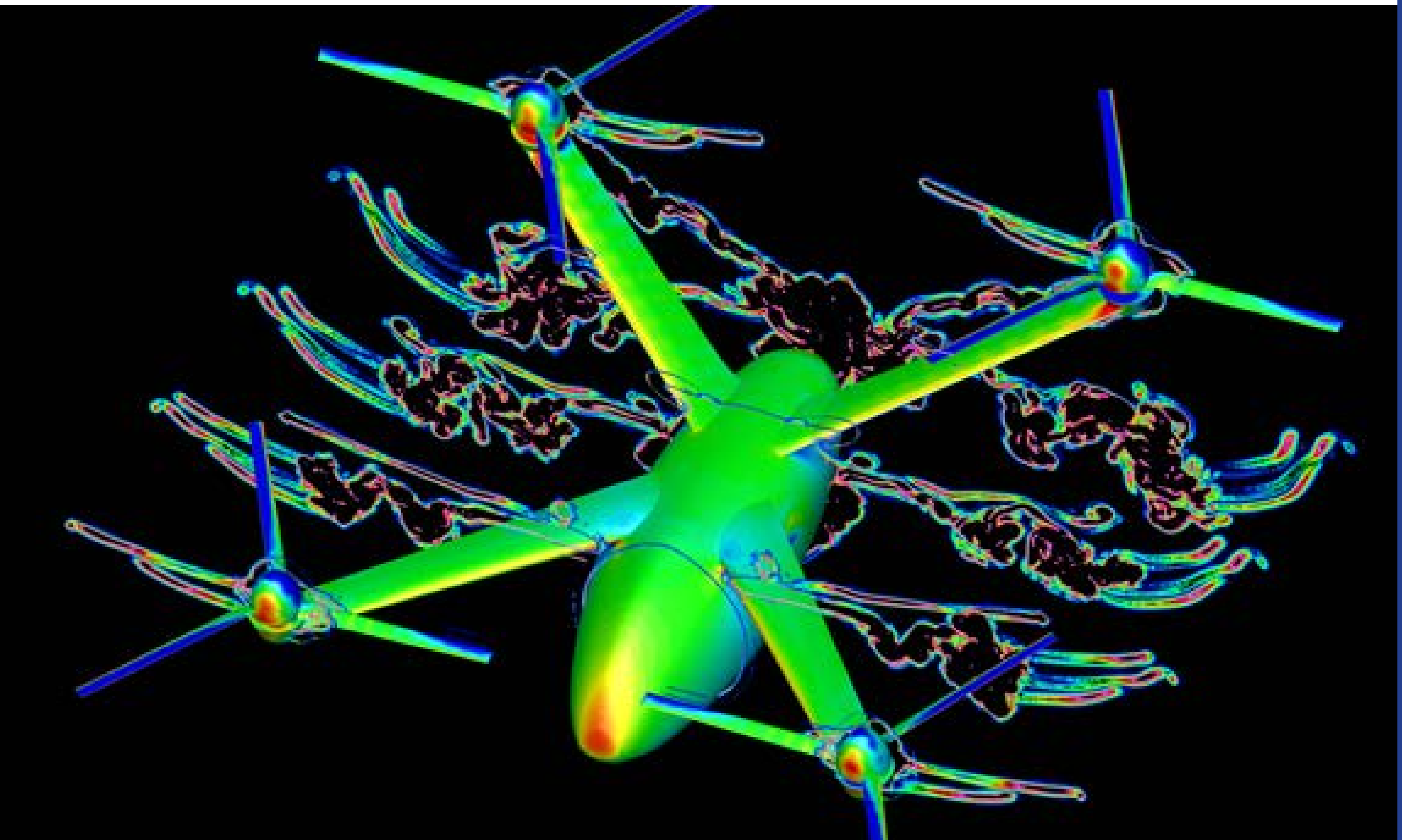
National Aeronautics and
Space Administration



NASA EXPLORES
Aeronautics Modeling

For more than 30 years, the NASA Advanced Supercomputing (NAS) Division has been one of the agency's premier aerospace numerical modeling and simulation resources, supporting aeronautics missions and projects from rotorcraft to supersonic flight. Researchers, engineers, and computational fluid dynamics (CFD) experts in the Computational Aerosciences and Computational Physics branches at NAS combine suites of code and tools with powerful supercomputing resources to better understand the complex flows within and around aircraft in order to improve flight efficiency, validate new designs, and reduce the impact on the planet.

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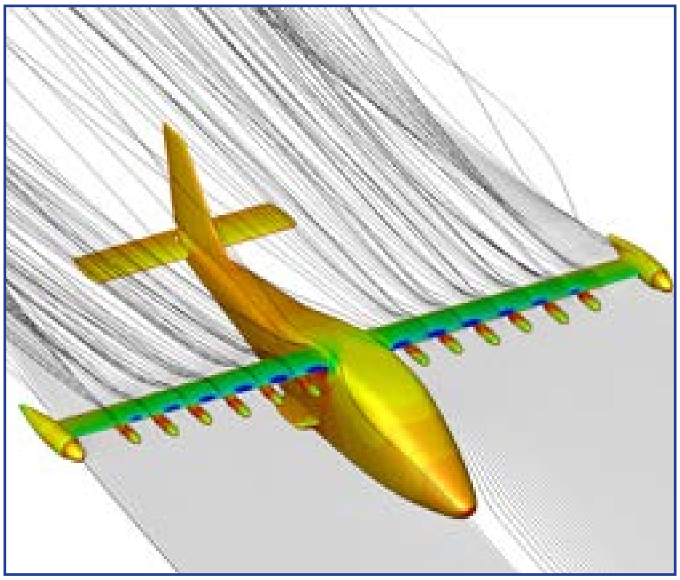
NASA ADVANCED SUPERCOMPUTING (NAS) DIVISION

Advanced Air Transport Technology

In support of NASA's Advanced Air Transport Technology (AATT) Project, which seeks to advance fixed wing aircraft by improving energy efficacy and reducing the environmental impact of air transportation, researchers at the NASA Advanced Supercomputing (NAS) Division are using in-house computational fluid dynamics (CFD) software to validate and model several different types of fixed-wing aircraft. This work includes accurate prediction of sonic booms, airframe designs for new propulsion systems, simulating the noise created by aircraft landing gear, and validation of transonic truss-braced wing vehicle designs to improve fuel economy.



This X-57 flow visualization is a computational fluid dynamics (CFD) solution computed using the Launch Ascent and Vehicle Aerodynamics (LAVA) curvilinear flow solver. Surface pressure distribution is shown on the aircraft–where blue and red contours correspond to low and high pressure, respectively. Streamlines in the surrounding flow field also provided a useful method to qualitatively analyze effects of the high-lift propellers modeled using actuator zone techniques, illustrating their influence on flow over the aircraft. James C. Jensen, Daniel Maldonado, NASA/Ames

Transformational Tools and Technologies

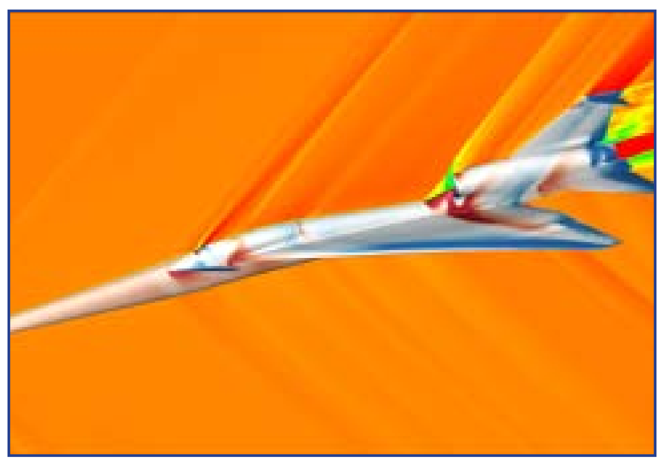
NAS has always been at the cutting edge of the development of new computational tools to understand and advance design and engineering in aviation. CFD experts at NAS support several endeavors under the Transformational Tools and Technologies (TTT) Project, including development of boundary-layer transition modeling techniques; multi-disciplinary design, analysis, and optimization tools; novel high-order methods; Lattice-Boltzmann methods; uncertainty quantification; and wall-modeled large-eddy simulation methods for computational certification of new aircraft designs.

Flight Demonstration Vehicles

X-planes—experimental aircraft used to test and evaluate new technologies and aerodynamic concepts—have been part of NASA's history for more than 60 years. As technology has advanced, the use of computational tools and resources for early design and validation of X-planes has been increasingly vital. Engineers and researchers at NAS are putting in-house tools and technologies to the test on new X-plane designs, supporting the development of both the X-57 Maxwell all-electric vehicle and the X-59 Low Boom Flight Demonstrator concepts, along with other research under NASA's Commercial Supersonic Technology (CST) Project.

Multi-Rotor Vehicles

Aerodynamic researchers at NAS are putting their skills to work on multi-rotor and vertical-lift flight, supporting the agency's Revolutionary Vertical Lift Technology (RVLT) and Advanced Air Mobility (AAM) projects to develop new aircraft that can be used in urban or underserved areas due to take-off requirements. Our experts are developing and analyzing the performance of drone and air taxi vehicle designs, improving energy efficiency, and reducing the noise generated by these vehicles.



A CFD flow visualization for a version of the X-59 supersonic aircraft concept. The surface is colored by the coefficient of pressure, and the symmetry plane is colored by the Mach number. Visualizations like this are used to help determine which features of the aircraft are contributing to the pressure signature below the aircraft which causes sonic booms. James C. Jensen, NASA/Ames

Front Image: High-fidelity CFD flow visualization of NASA's six-passenger quadcopter concept for urban air mobility in edgewise flight (front-oblique view). The vehicle surface pressure is shown in blue (low) and red (high). Line contours show the vorticity magnitude (blue is low, magenta is high) at four vertical planes: one at the front rotors; two downstream of the front rotors; and one at the rear rotors. Rotor-rotor interactions are reduced by moving the rear rotors above the wake from the front rotors, shown as vorticity contours at the rear rotors' plane. Patricia Ventura Diaz, NASA/Ames